

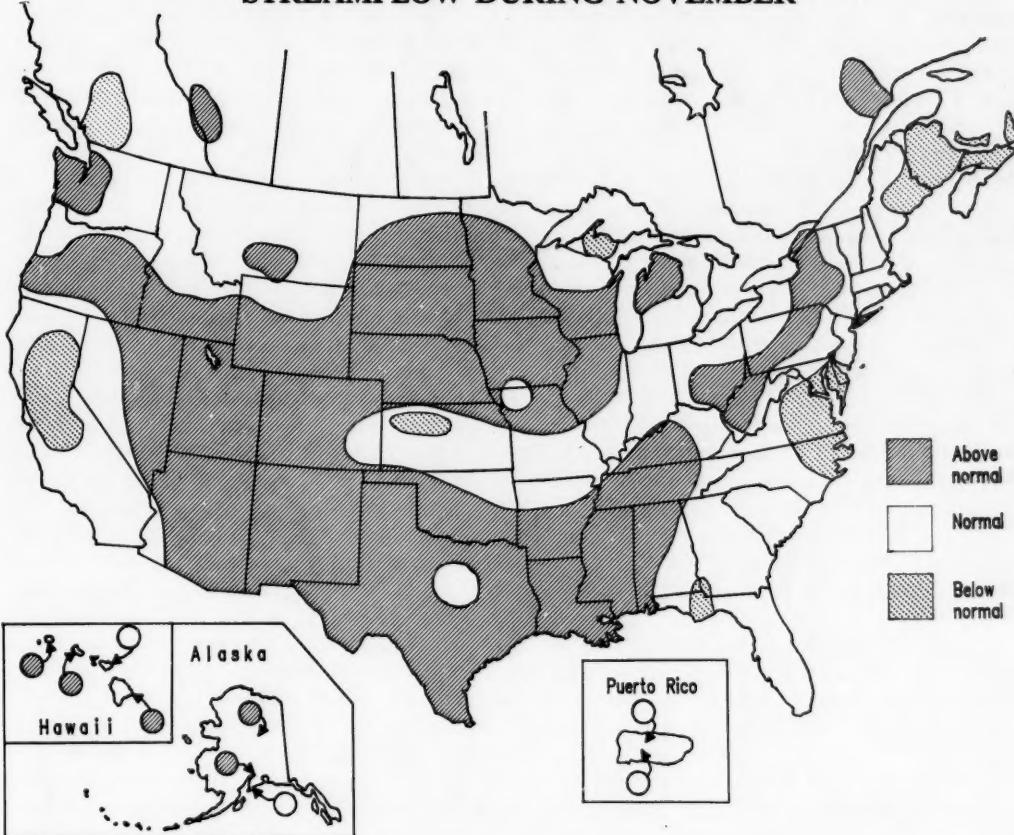
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

NOVEMBER 1986

STREAMFLOW DURING NOVEMBER



Severe floods occurred in Washington State November 23-25 as over 7 inches of rain fell in 24 hours in some areas. Chehalis River near Grand Mound peaked at 51,100 cubic feet per second (cfs), recurrence interval about 50 years, making it one of the four streams with peak discharges exceeding former peaks of record in the area.

Streamflow was in the normal to above-normal range at about 91 percent of the 192 index stations in southern Canada and the United States during November compared to 85 percent in those ranges for last month.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged a record-breaking 1,234,400 cfs during November (3 percent higher than November 1973), 85 percent above median, but 9 percent below last month's record-breaking combined flow.

Great Lakes monthly average levels for November remained well above median on all of the lakes and contents of 87 percent of reporting reservoirs were near or above average for the end of November.

SURFACE-WATER CONDITIONS DURING NOVEMBER 1986

Severe floods occurred in Washington State (see map on page 3) November 23-25 as over 7 inches of rain fell in 24 hours in some areas. Chehalis River near Grand Mound peaked at 51,100 cubic feet per second (cfs), recurrence interval about 50 years, making it one of the four streams with peak discharges exceeding former peaks of record (see table on page 3) in the area. Two deaths were reported in Sultan, the town of Snoqualmie was partially evacuated, and some persons in the area of Sumner were evacuated. About 1,000 skiers were temporarily isolated near Mt. Baker when flood waters damaged bridge approaches because a river channel had silted in heavily (flood frequencies for peak discharges on streams in the area were on the order of 2 to 3 years), but a temporary bridge opened the area to travel. No damage estimates were available.

Streamflow generally increased seasonally in Hawaii, the Pacific Northwest, Nevada, Saskatchewan, South Dakota, most of the area between Arkansas-Louisiana and the Atlantic coast, and also northward along the coastal States through Maine. Streamflow increased contraseasonally in Puerto Rico, increased variably in Georgia and New Mexico, and changed variably in Utah, Arizona, Nebraska, Pennsylvania, New York, Quebec, New Brunswick, and Nova Scotia. Streamflow decreased in the rest of southern Canada and the United States; seasonally in Alaska, British Columbia, Alberta, Montana, Colorado, Kansas, Oklahoma, Missouri, and Florida; contraseasonally in California, Idaho, Wisconsin, Michigan, Indiana, Ohio, and Vermont; variably in Wyoming, Texas, Ontario, Minnesota, Iowa, and North Dakota. The map on page 4 indicates areas where streamflow has persisted in the above- or below-normal range during November after being in a different range during October.

Streamflow was in the normal to above-normal range at about 91 percent of the 192 index stations in southern Canada and the United States during November (see table on page 10 for detailed breakdown), compared to 85 percent in those ranges for last month. The total of the mean flows at the 192 stations was 2,299,340 cfs for November,

79 percent above the total of the median flows, but down 12 percent from the total of the means for last month (2,605,280 cfs and 122 percent of median).

New maximum monthly mean discharges for November occurred at seven index stations (see table on page 4), most of them in the West. For example, the monthly mean discharge of 7,091 cfs on the Colorado River near Cisco, Utah, was the highest November flow in 75 years of record, exceeding that of November 1941 by 200 cfs.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged a record-breaking 1,234,400 cfs during November (3 percent higher than November 1973), 85 percent above median, but 9 percent below last month's record-breaking combined flow. Monthly mean flow of the St. Lawrence River at Cornwall, Ontario, was the highest for November in 126 years of record, averaging 337,900 cfs (36 percent above median) and was in the above-normal range for the 22nd consecutive month. Monthly mean flow of the Mississippi River at Vicksburg, Mississippi, averaged an above-normal 804,100 cfs (2nd only to the 825,000 cfs of November 1973) after a record-breaking October mean, while monthly mean flow of the Columbia River at The Dalles, Oregon, averaged 93,400 cfs (6 percent above median) and was in the normal range.

Provisional data from the National Weather Service show that precipitation was above average over most of the Nation during November (see maps on page 5), with record-high totals for November falling at: Hilo, Hawaii (34.93 inches); Roswell, New Mexico (1.88 inches); Brownsville, Texas (7.61 inches); Lake Charles, Louisiana (8.23 inches); Williston, North Dakota (1.15 inches). In sharp contrast, precipitation at five stations in Michigan was the lowest of record for November; Alpena (0.58 inches), Grand Rapids (0.95 inches), Houghton Lake (0.45 inches), Marquette (1.04 inches), and Muskegon (0.63 inches). Well below-average precipitation fell across the southwestern Great Lakes States, the central Great Plains, most of the Great Basin

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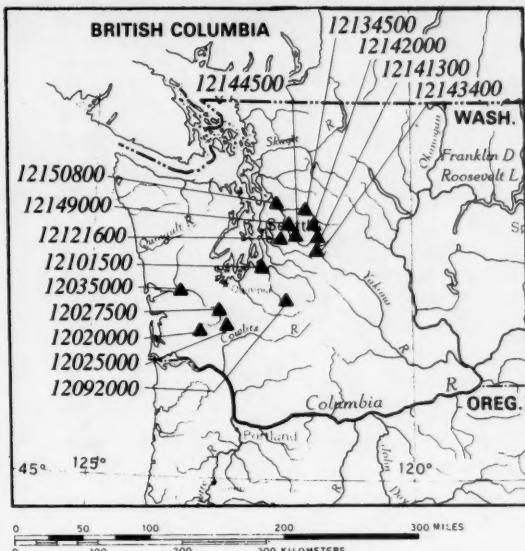
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and parts of California, Oregon, Washington, Texas, Florida, North Carolina, and Virginia.

Contents of 87 percent of reporting reservoirs were near or above average for the end of November, with 61 percent of reservoirs having contents significantly above average, including most of those in Vermont, Oklahoma, Texas, and Colorado. Most reservoirs (61 percent) had significant increases (more than 5 percent) in contents during the month. Only three reservoirs—First Connecticut Lake (Connecticut), Lewis and Clark Lake (South Dakota), and Pend Oreille Lake (Idaho)—had both a significant decline in contents during the month and below-average contents for the end of the month.

Hydrographs for eight large rivers located in the mid-continent are given on page 6. Flows at four of the sites have been in the above-normal flow range for many consecutive months: Red River of the North at Grand Rapids, North Dakota (19 months); Mississippi River near Anoka, Minnesota (19 months); Minnesota River near Jordan, Minnesota (15 months); Mississippi River at Keokuk, Iowa (15 months). Flow of the Mississippi River at St. Paul, Minnesota (hydrograph on page 10), which is just downstream from the confluence of the Mississippi and Minnesota Rivers, has been in the above-normal flow

(Continued on page 11.)



Location of sites in Washington for which flood data are given.

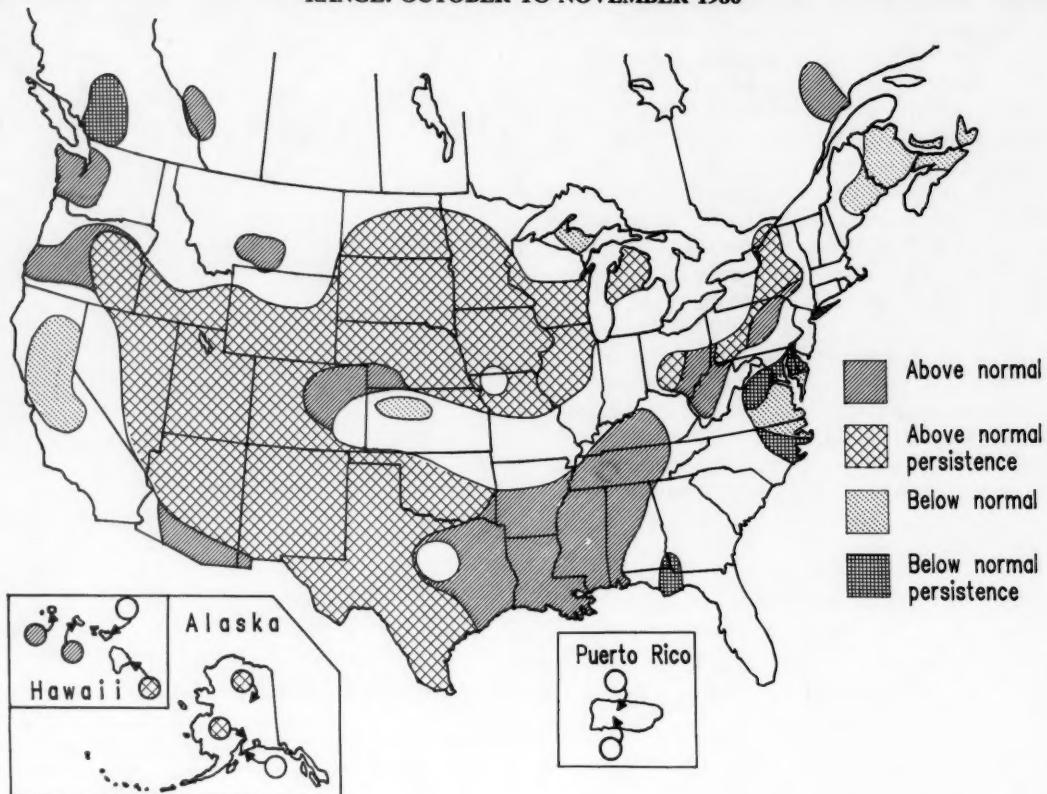
Provisional data; subject to revision

FLOOD DATA FOR SELECTED SITES IN WASHINGTON, NOVEMBER 1986.

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood					
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recu- rence interval (years)	
									Cfs	Cfs per square mile		
CHEHALIS RIVER BASIN												
12020000	Chehalis River near Doty.....	113	1940- 1930-31, 1943-81, 1933-	Jan. 20, 1972	18.36	22,800	Nov. 24	16.31	17,900	158	20	
12025000	Newaukum River near Chehalis.....	155		Dec. 2, 1977	12.49	10,300		12.76	10,700	69	50	
12027500	Chehalis River near Grand Mound.....	895	1929- 1930- 1943-81, 1933-	Jan. 21, 1972	18.21	49,200	25	18.41	51,100	57	50	
12035000	Satsop River near Satsop.....	299	1930- 1935	Jan. 22, 1935	38.90	46,600	23	35.93	40,100	134	20	
PUYALLUP RIVER BASIN												
12092000	Puyallup River near Electron.....	92.8	1909-33, 1945-49, 1958-	Nov. 22, 1959	^a 11.9	10,800	24	7.64	9,010	97	15	
12101500	Puyallup River at Puyallup.....	948	1915-	Dec. 10, 1933	31.0	57,000	24	27.80	42,400	45	40	
LAKE WASHINGTON BASIN												
12121600	Issaquah Creek near Issaquah.....	56.6	1964-	Dec. 3, 1975	11.46	2,870	24	13.20	3,400	60	25	
SNOHOMISH RIVER BASIN												
12134500	Skykomish River near Gold Bar.....	535	1929- 1962-	Dec. 26, 1980	21.38	90,400	23	19.90	77,100	144	15	
12141300	Middle Fork Snoqualmie River near Tanner.....	154		Dec. 2, 1977	14.93	30,200	23	14.68	29,000	188	20	
12142000	North Fork Snoqualmie River near Snoqualmie Falls.....	64.0	1930-60, 1962-	Feb. 26, 1932	^a 17.5	15,800	23	12.32	12,600	197	10	
12143400	South Fork Snoqualmie River near Garcia.....	41.6	1961-	Nov. 19, 1962	11.96	7,090	23	8.33	8,300	200	40	
12144500	Snoqualmie River near Snoqualmie.....	375	1899, 1903-04, 1908-32, 1959-	Nov. 23, 1959	19.78	61,000	24	19.35	57,600	154	20	
12149000	Snoqualmie River near Carnation.....	603	1929-	Feb. 27, 1932	59.88	59,500	24	59.82	56,500	94	20	
12150800	Snohomish River near Monroe.....	1,537	1964-	Dec. 4, 1975	22.92	115,000	24	20.68	90,600	59	10	

^aSite and datum then in use.

PERSISTENCE IN, OR MOVEMENT INTO, THE BELOW-NORMAL OR ABOVE-NORMAL FLOW RANGE: OCTOBER TO NOVEMBER 1986



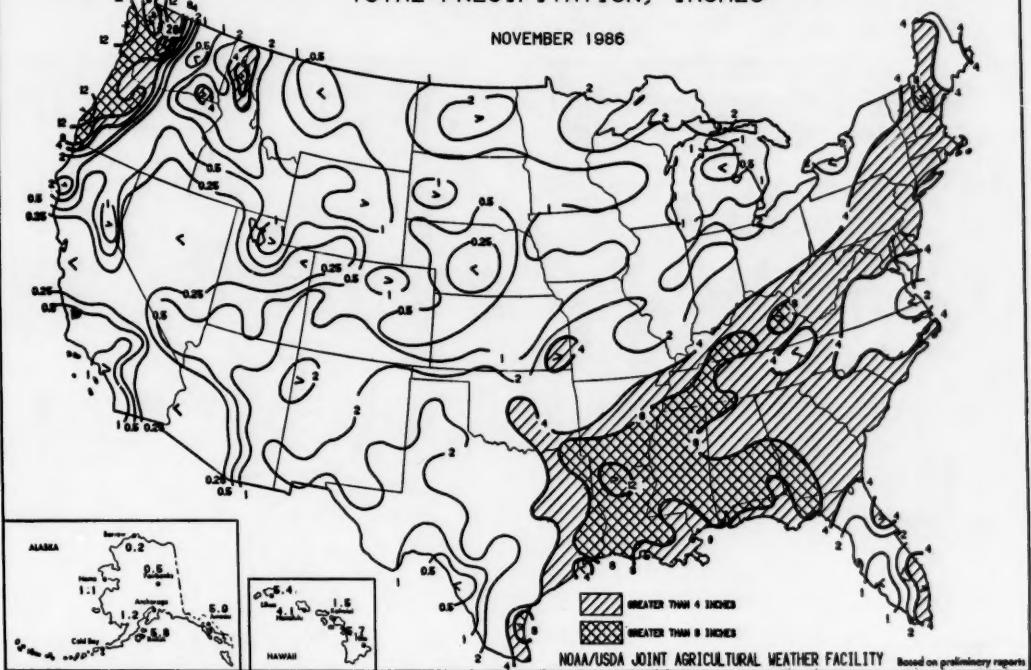
NEW MAXIMUMS DURING NOVEMBER 1986 AT STREAMFLOW INDEX STATIONS

Station number	Stream and place of determination	Drainage area (square miles)	Years of record	Previous November maximums (period of record)		November 1986			
				Monthly mean in cfs (year)	Daily mean in cfs (year)	Monthly mean in cfs	Percent of median	Daily mean in cfs	Day
04264331	St. Lawrence River at Cornwall, Ont. near Massena, N. Y.	298,800	126	296,600 (1975)	300,000 (1973)	337,900	136	342,000	(*)
06441500	Bad River near Fort Pierre, S. Dak.	3,107	58	12.5 (1977)	146 (1956)	15.8	52,667	35	24
06630000	North Platte River above Seminole Reservoir, near Sinclair, Wyo.	4,175	47	750 (1984)	991 (1961)	750	197	959	18
06800500	Elkhorn River at Waterloo, Nebr.	6,900	66	1,850 (1982)	6,740 (1982)	2,180	369	3,140	9
09180500	Colorado River near Cisco, Utah	24,100	75	6,891 (1984)	7,610 (1941)	7,091	196	9,930	2
09315000	Green River at Green River, Utah	44,850	87	6,376 (1982)	8,710 (1957)	6,461	233	7,000	23
09379500	San Juan River near Bluff, Utah	23,000	72	3,899 (1965)	6,120 (1965)	4,611	525	9,170	3

*Occurred more than once.

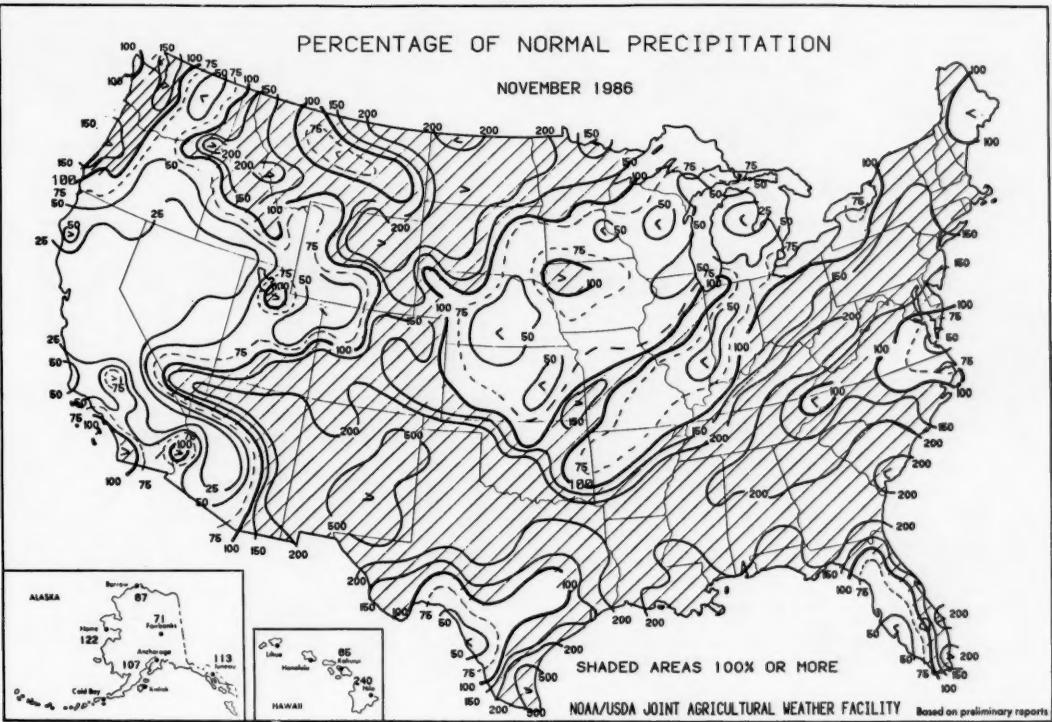
TOTAL PRECIPITATION, INCHES

NOVEMBER 1986



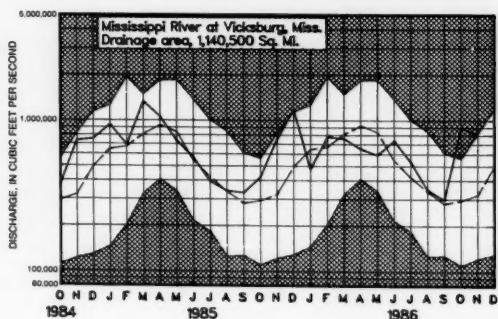
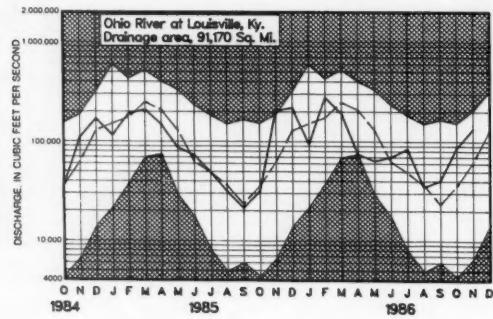
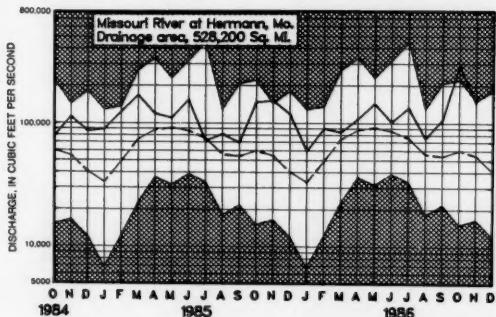
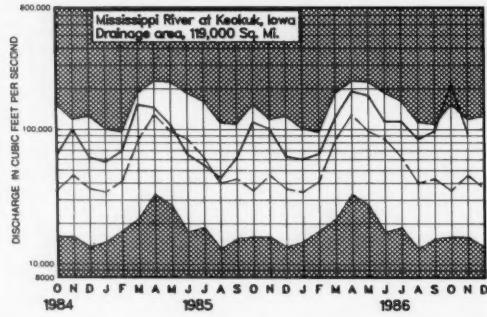
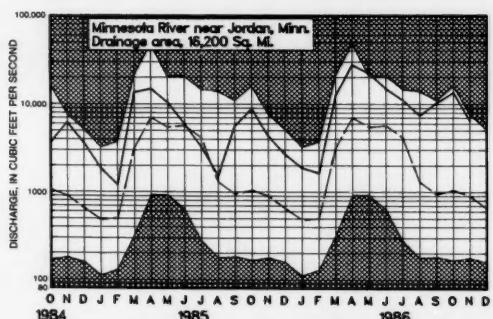
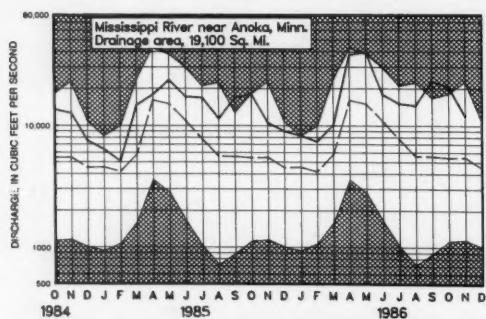
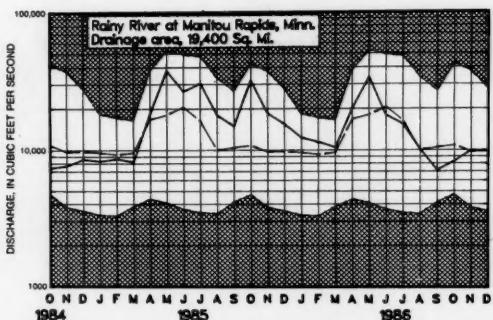
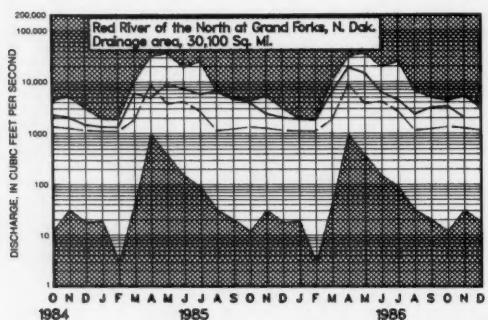
PERCENTAGE OF NORMAL PRECIPITATION

NOVEMBER 1986



FLOW OF LARGE RIVERS IN THE MIDCONTINENT

Unshaded area indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



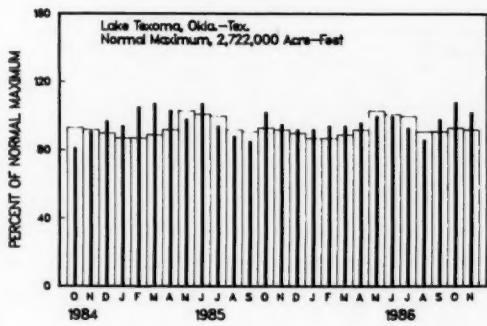
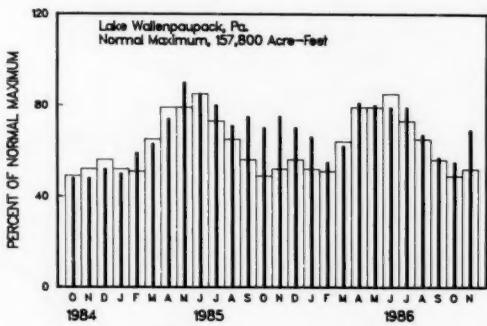
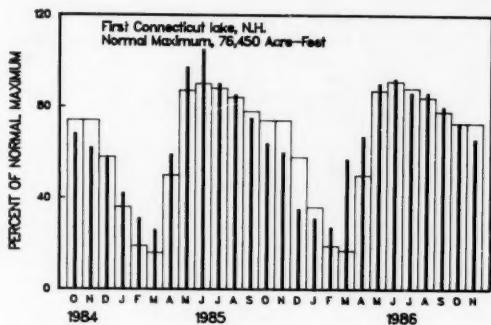
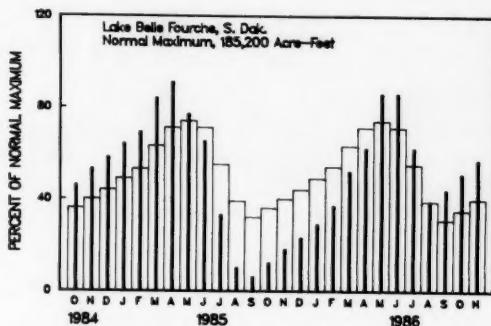
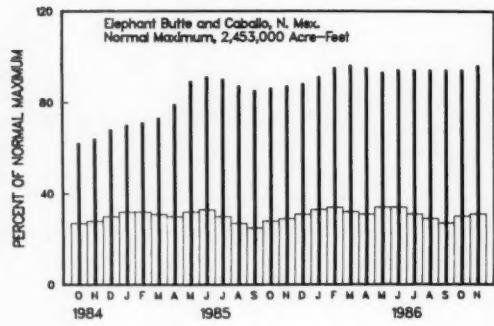
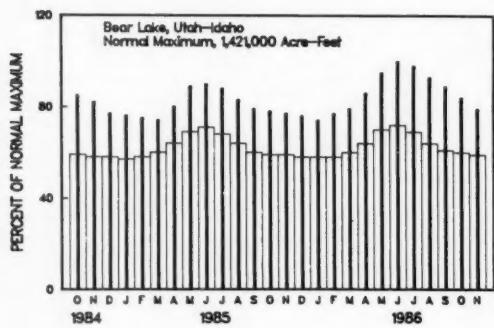
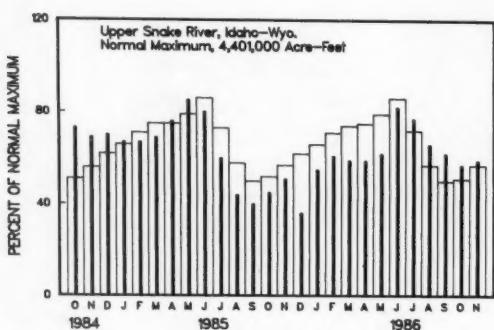
FLOW OF LARGE RIVERS DURING NOVEMBER 1986

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1980 (cubic feet per second)	November 1986			
				Monthly mean discharge (cubic feet per second)	Percent of median monthly discharge, 1951-80	Change in discharge from previous month (percent)	Discharge near end of month
				Cubic feet per second	Million gallons per day	Date	
01014000	St. John River below Fish River at Fort Kent, Maine	5,690	9,647	5,530	78	-42	3,000 1,900 30
01318500	Hudson River at Hadley, N.Y.	1,664	2,909	2,500	104	-7	3,590 2,320 30
01357500	Mohawk River at Cohoes, N.Y.	3,456	5,734	9,230	194	+84	12,600 8,140 30
01463500	Delaware River at Trenton, N.J.	6,780	11,750	13,590	138	+234	34,500 22,300 29
01570500	Susquehanna River at Harrisburg, Pa.	24,100	34,530	47,160	191	+216	124,900 80,720 30
01646500	Potomac River near Washington, D.C.	11,560	11,490	14,410	99	+153	7,070 4,569 30
02105500	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	5,005	1,343	69	+37	1,700 1,100 30
02131000	Pee Dee River at Peedee, S.C.	8,830	9,851	4,740	105	+114	7,550 4,879 26
02226000	Altamaha River at Doctortown, Ga.	13,600	13,880	4,201	84	+114	7,490 4,840 30
02320500	Suwannee River at Branford, Fl.	7,880	6,987	2,720	82	-7	2,800 1,810 30
02358000	Apalachicola River at Chattahoochee, Fl.	17,200	22,570	8,030	72	+54	10,000 6,000 30
02467000	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	23,300	25,690	407	+414	92,000 59,500 30
02489500	Pearl River near Bogalusa, La.	6,630	9,768	7,865	307	+279	33,600 21,720 30
03049500	Allegheny River at Natrona, Pa.	11,410	19,480	19,320	141	-5	23,800 15,380 24
03085000	Monongahela River at Braddock, Pa.	7,337	12,510	26,270	340	+186	34,200 22,100 22
03193000	Kanawha River at Kanawha Falls, W.Va.	8,367	12,590	12,330	156	+161	9,560 6,178 23
03234500	Scioto River at Higby, Ohio.	5,131	4,547	4,363	269	-14	14,500 9,370 30
03294500	Ohio River at Louisville, Ky. ²	91,170	116,00	134,400	215	+55	152,300 98,430 25
03377500	Wabash River at Mount Carmel, Ill.	28,635	27,220	12,100	109	-40	24,200 15,640 30
03469000	French Broad River below Douglas Dam, TN.	4,543	6,798	4,457	95	+131	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wis. ²	6,150	4,163	5,665	162	-57	4,782 3,090 30
04264331	St. Lawrence River at Cornwall, Ontario—near Massena, N.Y. ³	298,800	242,700	337,900	136	+4	339,000 219,100 30
02NG001	St. Maurice River at Grand Mere, P.Q.	16,300	25,150	16,700	92	-47	19,600 12,670 28
05082500	Red River of the North at Grand Forks, N.Dak.	30,100	2,551	2,009	159	-40	2,450 1,583 25
05133500	Rainy River at Manitou Rapids, Minn.	19,400	11,830	10,000	102	+20	10,200 6,590 20
05330000	Minnesota River near Jordan, Minn.	16,200	3,402	6,529	726	-52	4,800 3,100 30
05331000	Mississippi River at St. Paul, Minn.	36,800	10,610	18,540	295	-51	15,700 10,150 30
05365500	Chippewa River at Chippewa Falls, Wis.	5,600	5,100	4,817	125	-52	3,520 2,275 30
05407000	Wisconsin River at Muscoda, Wis.	10,300	8,617	9,302	142	-63	8,512 5,501 30
05446500	Rock River near Joslin, Ill.	9,551	5,873	8,970	237	-48	8,300 5,360 30
05474500	Mississippi River at Keokuk, Iowa	119,000	62,620	94,140	205	-56	85,600 55,320 30
06214500	Yellowstone River at Billings, Mont.	11,796	7,038	4,540	117	-10	4,390 2,837 26
06934500	Missouri River at Hermann, Mo.	524,200	79,490	146,600	268	-49	126,000 81,400 29
07289000	Mississippi River at Vicksburg, Miss. ⁴	1,140,500	576,600	804,100	251	-11	704,000 455,000 28
07331000	Washita River near Dickson, Okla.	7,202	1,368	4,771	1211	-28	3,500 2,260 30
08276500	Rio Grande below Taos Junction Bridge, near Taos, N.Mex.	9,730	725	1,325	316	+50	1,380 891 30
09315000	Green River at Green River, Utah	44,850	6,298	6,461	233	+9	...
11425500	Sacramento River at Verona, Calif.	21,257	18,820	10,316	79	-19	11,200 7,240 30
13269000	Snake River at Weiser, Idaho	69,200	18,050	21,200	141	-9	24,200 15,640 30
13317000	Salmon River at White Bird, Idaho	13,550	11,250	5,270	102	-6	5,130 3,315 30
13342500	Clearwater River at Spalding, Idaho	9,570	15,480	7,490	148	+75	5,310 3,431 27
14105700	Columbia River at The Dalles, Oreg. ⁵	237,000	193,100	193,400	106	-24	126,500 81,760 30
14191000	Willamette River at Salem, Oreg.	7,280	123,510	137,900	142	+450	95,800 61,920 30
15515500	Tanana River at Nenana, Alaska	25,600	23,460	9,600	115	-50	7,300 4,720 30
08MF005	Fraser River at Hope, B.C.	83,800	96,290	45,900	78	-13	44,840 28,980 28

¹Adjusted.²Records furnished by Corps of Engineers.³Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.⁴Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.⁵Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

[NOTE: Drainage areas of St. Lawrence River at Cornwall, Ont., and Green River at Green River, Utah, have been corrected.]

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1986

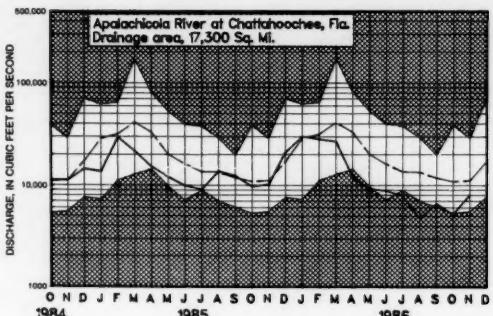
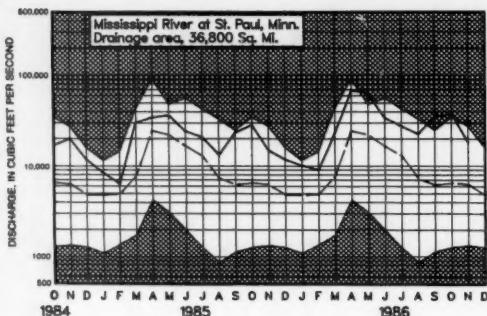
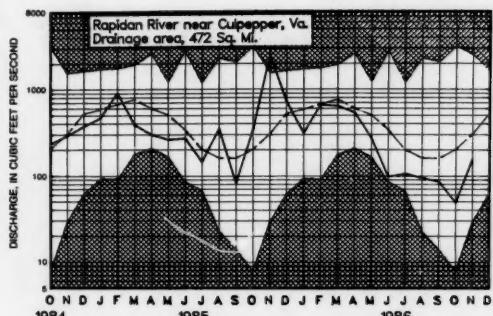
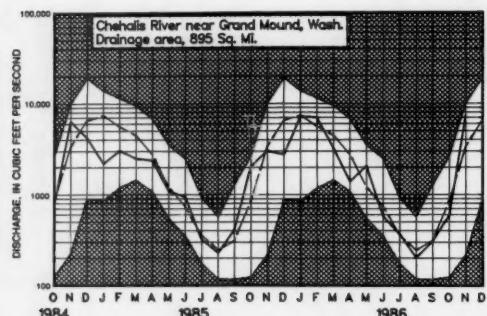
[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Reservoir				Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Reservoir				Normal maximum (acre-feet) ^a	
	Percent of normal maximum	End of Nov. 1985	End of Nov.	Average for end of Nov.	End of Oct. 1986	Percent of normal maximum	End of Nov. 1985	End of Nov.	Average for end of Nov.	End of Oct. 1986	
NOVA SCOTIA						NEBRASKA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P).....	36	22	40	41	b226,300	Lake McConaughy (IP).....	80	77	68	78	1,948,000
QUEBEC						OKLAHOMA					
Allard (P).....	82	89	62	79	280,600	Eufaula (FPR).....	104	104	90	124	2,378,000
Gouin (P).....	94	78	69	93	6,954,000	Keystone (FPR).....	97	137	98	149	661,000
MAINE						Tenkiller Ferry (FPR).....	113	113	99	139	628,200
Seven reservoir systems (MP).....	55	56	56	57	4,107,000	Lake Altus (FIMR).....	100	16	44	100	133,000
NEW HAMPSHIRE						Lake O'The Cherokees (FPR).....	96	122	83	111	1,492,000
First Connecticut Lake (P).....	66	60	73	73	76,450	NEBRASKA-TEXAS					
Lake Francis (FPR).....	78	88	78	82	99,310	Lake Texoma (FMPRW).....	102	95	92	108	2,722,000
Lake Winnipesaukee (PR).....	68	65	59	72	165,700	TEXAS					
VERMONT						Bridgeport (IMW).....	92	81	47	92	386,400
Harriman (P).....	81	86	65	69	116,200	Canyon (FMR).....	97	99	77	104	385,600
Somerset (P).....	88	85	71	78	57,390	International Amistad (FIMPW).....	82	73	85	81	3,497,000
MASSACHUSETTS						International Falcon (FIMPW).....	54	39	76	47	2,668,000
Cobble Mountain and Borden Brook (MP).....	70	73	72	69	77,920	Livingston (IMW).....	104	106	86	101	1,788,000
NEW YORK						Possible Kingdom (IMPRW).....	95	93	98	97	570,200
Great Sacandaga Lake (FPR).....	66	73	56	74	786,700	Red Bluff (P).....	65	22	27	63	307,000
Indian Lake (FMP).....	69	94	60	73	103,300	Toledo Bend (P).....	85	92	81	85	4,472,000
New York City reservoir system (MW).....	84	65	65	74	1,680,000	Twin Buttes (FIM).....	43	15	29	41	177,800
NJ						Lake Kemp (IMW).....	102	93	86	124	268,000
Wanaque (M).....	68	93	66	60	85,100	Lake Meredith (FWM).....	29	30	38	27	796,900
PENNSYLVANIA						Lake Travis (FIMPW).....	100	88	78	105	1,144,000
Allegheny (FPR).....	35	50	35	38	1,180,000	MONTANA					
Pymatuning (FMR).....	80	104	80	85	188,000	Canyon Ferry (FIMPR).....	87	79	89	89	2,043,000
Raystown Lake (FR).....	67	68	53	65	761,900	Fort Peck (FPR).....	85	75	85	85	18,910,000
Lake Wallenpaupack (PR).....	69	75	52	55	157,800	Hungry Horse (FPR).....	80	82	84	80	3,451,000
MARYLAND						WASHINGTON					
Baltimore municipal system (M).....	60	72	83	55	261,900	Ross (PR).....	88	82	79	89	1,052,000
NORTH CAROLINA						Franklin D. Roosevelt Lake (IP).....	99	84	100	99	5,022,000
Bridgewater (Lake James) (P).....	95	94	78	92	288,800	Lake Chelan (PR).....	71	73	65	83	676,100
Narrows (Bardin Lake) (P).....	84	97	92	84	128,900	Lake Cushman (PR).....	55	53	82	55	359,500
High Rock Lake (P).....	55	83	55	58	234,800	Lake Merwin (P).....	99	92	91	104	245,600
SOUTH CAROLINA						IDAHO					
Lake Murray (P).....	85	82	61	83	1,614,000	Boise River (4 reservoirs) (FIP).....	53	53	54	54	1,235,000
Lakes Marion and Moultrie (P).....	83	86	64	83	1,862,000	Coeur d'Alene Lake (P).....	67	55	54	53	238,500
SOUTH CAROLINA-GEORGIA						Pend Oreille Lake (FIP).....	35	43	49	48	1,561,000
Clark Hill (FIP).....	35	65	52	31	1,730,000	IDAHO-WYOMING					
GEORGIA						Upper Snake River (8 reservoirs) (MP).....	59	51	57	57	4,401,000
Burton (PR).....	97	91	58	96	104,000	WYOMING					
Sinclair (MPR).....	91	90	74	87	214,000	Boysen (FIP).....	87	77	80	90	802,000
Lake Sidney Lanier (FMPR).....	38	51	50	35	1,686,000	Buffalo Bill (IP).....	65	62	71	63	421,300
ALABAMA						Keyhole (F).....	34	29	42	34	193,800
Lake Martin (P).....	81	78	61	78	1,375,000	Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I).....	67	59	48	66	3,056,000
TENNESSEE VALLEY						COLORADO					
Clinch Projects: Norris and Melton Hill Lakes (FPR).....	33	28	31	29	2,293,000	John Martin (FIR).....	71	79	14	62	364,400
Douglas Lake (FPR).....	26	27	18	19	1,394,000	Taylor Park (IR).....	71	64	54	72	106,200
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR).....	57	50	42	52	1,012,000	Colorado-Big Thompson project (I).....	82	74	57	82	730,300
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR).....	43	44	35	45	2,880,000	COLORADO RIVER STORAGE PROJECT					
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR).....	44	26	41	38	1,478,000	Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (FIPR).....	91	89	...	92	31,620,000
WISCONSIN						UTAH-IDAHO					
Chippewa and Flambeau (PR).....	86	85	76	91	365,000	Bear Lake (IPR).....	79	77	59	84	1,421,000
Wisconsin River (21 reservoirs) (PR).....	80	92	66	92	399,000	CALIFORNIA					
MINNESOTA						Folsom (FIP).....	51	50	52	57	1,000,000
Mississippi River headwater system (FMR).....	34	30	28	36	1,640,000	Hetch Hetchy (MP).....	51	51	43	67	360,400
NORTH DAKOTA						Isabella (FIR).....	43	33	25	48	568,100
Lake Sakakawea (Garrison) (FIPR).....	91	80	87	93	22,700,000	Pine Flat (F).....	56	29	42	53	1,001,000
SOUTH DAKOTA						Clair Engle Lake (Lewiston) (P).....	73	64	70	75	2,438,000
Angostura (I).....	90	48	72	90	127,600	Lake Almanor (P).....	69	59	50	75	1,036,000
Belle Fourche (I).....	57	18	40	51	185,200	Lake Berryessa (FIMW).....	84	74	75	85	1,600,000
Lake Francis Case (FIP).....	50	56	50	65	4,834,000	Millerton Lake (F).....	29	46	41	28	503,200
Lake Oahe (FIP).....	86	74	87	87	22,530,000	Shasta Lake (FIPR).....	70	49	65	72	4,377,000
Lake Sharpe (FIP).....	101	100	95	99	1,725,000	CALIFORNIA-NEVADA					
Lewis and Clark Lake (FIP).....	85	92	92	94	432,000	Lake Tahoe (IPR).....	68	55	47	75	744,600
ARIZONA-NEVADA						NEVADA					
Lake Mead and Lake Mohave (FIMP).....	92	92	71	92	27,000,000	Rye Patch (I).....	65	56	58	66	194,300
ARIZONA						CALIFORNIA					
San Carlos (IP).....	71	84	20	66	935,100	Folsom (FIP).....	51	50	52	57	1,000,000
Salt and Verde River system (IMPR).....	81	82	39	79	2,019,000	Hetch Hetchy (MP).....	51	51	43	67	360,400
NEW MEXICO						Isabella (FIR).....	43	33	25	48	568,100
Conchas (FIR).....	93	85	79	87	330,100	Pine Flat (F).....	56	29	42	53	1,001,000
Elephant Butte and Caballo (FIPR).....	96	87	31	94	2,442,000	Clair Engle Lake (Lewiston) (P).....	73	64	70	75	2,438,000

^a1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second day.^bThousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

Unshaded area indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.

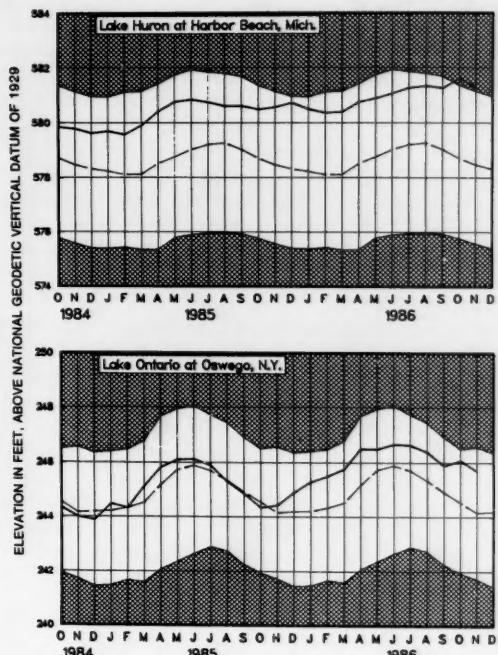
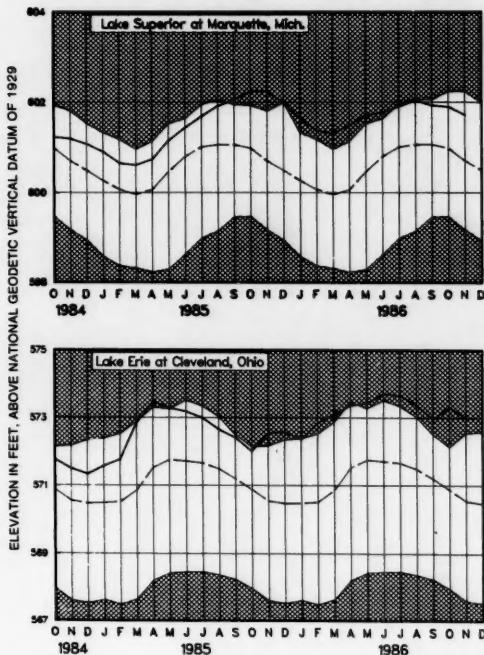


SUMMARY OF STREAMFLOW CONDITIONS AT INDEX GAGING STATIONS

Area	Number of sites reporting data	Flow Ranges					
		Below Normal		Normal		Above Normal	
		Sites	Percent	Sites	Percent	Sites	Percent
Conterminous United States.	164	13	7.9	70	42.7	81	49.4
Alaska, Hawaii, and Puerto Rico.	10	4	40.0	6	60.0
United States and Puerto Rico.	174	13	7.5	74	42.5	87	50.0
Southern Canada.....	18	5	27.8	11	61.1	2	11.1
Conterminous United States and southern Canada.	182	18	9.9	81	44.5	83	45.6
All sites.....	192	18	9.4	85	44.3	89	46.3

GREAT LAKES ELEVATIONS

Unshaded area indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Weather Service.



range for 16 months. Flows of the other four midcontinent rivers have been more variable: Missouri River at Herman, Missouri, has been in the normal to above-normal range for all 26 months; Rainy River at Manitou Rapids, Minnesota, has been in the normal to above-normal range for 25 of 26 months; Mississippi River at Vicksburg, Mississippi, has been in the normal to above-normal range for 24 of 26 months (April and May 1986 were below normal); Ohio River at Louisville, Kentucky, has been in the normal to above-normal range for 23 of 26 months (January, April, and May 1986 were below normal).

Streamflow conditions at four sites across the United States are shown by the hydrographs on page 10: Chehalis River near Grand Mound, Washington, went from below normal in October to above normal in November as a result of the heavy rains in the Pacific Northwest during November; Rapidan River near Culpeper, Virginia, has been below normal for 5 of the last 7 months; (Mississippi River at St. Paul, Minnesota, was discussed previously); Apalachicola River at Chattahoochee, Florida, has been

below normal for the last eight consecutive months and was also below normal during much of the 1985 water year.

Utah's Great Salt Lake remained at elevation 4,210.95 feet above National Geodetic Vertical Datum of 1929 from November 1-15, but rose to 4,211.05 feet by November 30, only 0.80 foot below the maximum of record reached June 3-8, 1986.

Great Lakes monthly average levels for November (provisional data from National Weather Service) remained well above median on all of the lakes as shown by the four hydrographs (Lake Huron and Lake Michigan are represented by the Lake Huron gage) above. Lake Huron (581.29 feet) and Lake Erie (573.01 feet) both were at record high average levels (above National Geodetic Vertical Datum of 1929) for November; Lake Superior, which set new monthly average record highs from October 1984 through June 1986, averaged 601.72 feet, 0.52 foot below the record average set in November 1985; Lake Ontario averaged 245.69 feet, 1.53 feet above last November but 0.87 foot below the November record high.

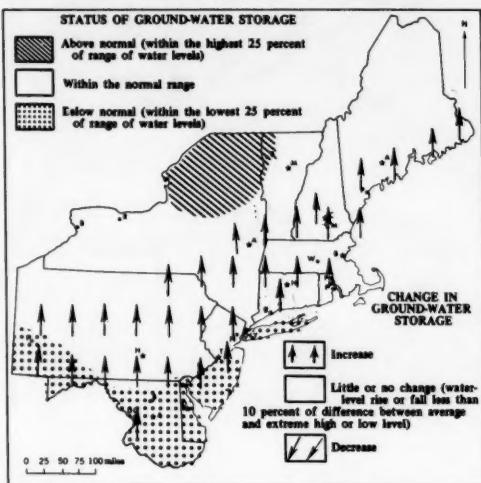
GROUND-WATER CONDITIONS DURING NOVEMBER 1986

Ground-water levels generally rose in most of the Northeast. (See map.) Levels declined at least slightly in parts of northern New England and in Delaware and southern New Jersey. Below-average water-level conditions persisted in southern New Jersey, Delaware, Maryland, and on Long Island, New York; levels remained above average in northeastern New York. Ground-water levels were near average in most of the remainder of the Northeast.

In the Southeastern States, ground-water levels rose in Mississippi, and also in most observation wells in West Virginia. Water levels declined in Virginia with trends mixed in other Southeastern States. Water levels were above average in Kentucky, and below average in Virginia, Arkansas, Louisiana, and Florida. Levels were mixed with respect to average in West Virginia and North Carolina. A new high water level for November was reached in the Glenville observation well in West Virginia. New November low levels were recorded in the key wells at Memphis, Tennessee, and on Cockspur Island in the Savannah area, Chatham County, Georgia, despite net rises in both wells during the month.

In the central and western Great Lakes States, ground-water levels rose in Ohio, declined in Wisconsin, Michigan, and Indiana, and mostly declined in Iowa. Water levels showed mixed trends in Minnesota. Water

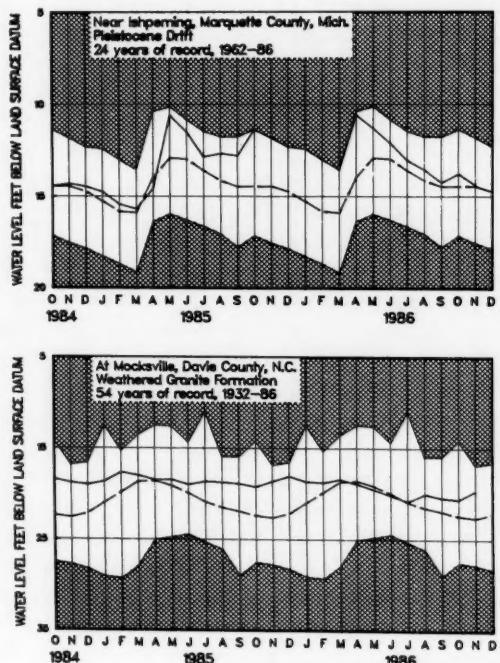
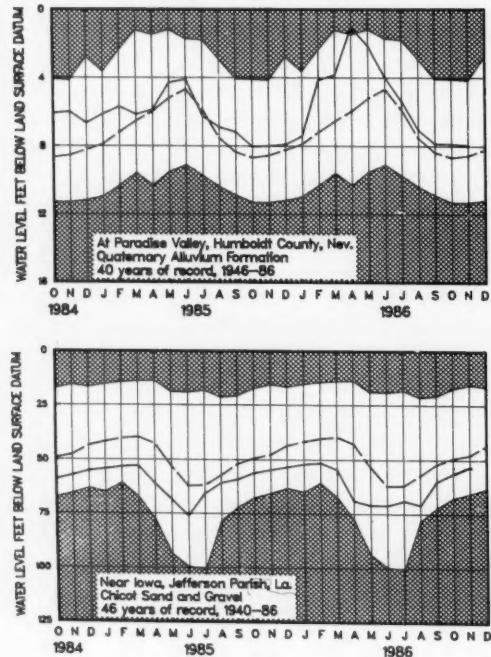
levels were above average in Iowa, and mixed with respect to average in other States. New November high levels, despite net declines during the month, were reported for



Map showing ground-water storage near end of November and change in ground-water storage from end of October to end of November.

MONTH-END GROUND-WATER LEVELS IN KEY WELLS

Unshaded area indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



key wells in the northern and south-central parts of Michigan's Lower Peninsula for the second consecutive month.

In the Western States, ground-water levels rose in North Dakota, New Mexico, and Texas, and declined in most of the key wells in Idaho. Trends were mixed in other Western States. Water levels were above average in North Dakota and Nebraska. Levels were mixed with respect

to average in other States. New high ground-water levels for November were recorded at wells in North Dakota, Nebraska, Nevada, and Kansas. New November low levels were reported, despite net rises at wells in Nevada, Kansas, and Texas. The level in the Berrendo-Smith observation well, in the Roswell artesian basin of the Pecos Valley in New Mexico, rose more than 2 feet to a new all-time high in 20 years of record.

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES—NOVEMBER 1986

Aquifer and Location	Water level in feet with reference to land-surface datum	Departure from average in feet	Net change in water level in feet since:		Year records began	Remarks
			Last month	Last year		
Glacial drift at Hanska, south-central Minnesota.	-5.26	+3.07	-0.45	-0.04	1942	
Glacial drift at Roscommon in north-central part of Lower Peninsula, Michigan.	-3.87	+1.01	-0.45	+0.17	1935	Nov. high.
Glacial drift at Marion, Iowa	-3.32	+3.19	-0.37	-0.11	1941	
Glacial drift at Princeton in northwestern Illinois.	-8.0	+6.2	-0.1	-1.8	1943	
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia.	-16.83	-0.54	-0.32	-3.04	1939	
Glacial outwash sand and gravel, Louisville, Kentucky (U.S. well no. 2).	-18.15	+7.17	-0.05	-1.17	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2).	-105.53	-15.91	+0.63	+1.06	1941	Nov. low.
Granite in eastern Piedmont Province, Chapel Hill, North Carolina (U.S. well no. 5).	-45.71	-2.32	-0.48	-2.32	1931	
Sparta Sand in Pine Bluff industrial area, Arkansas.	-223.95	-18.16	-2.55	-8.25	1958	
Eutaw Formation in the City of Montgomery, Alabama (U.S. well no. 4).	-25.1	-2.1	+2.0	-3.3	1952	
Limestone aquifer on Cockspur Island, Savannah area, Georgia (U.S. well no. 6).	-35.85	-8.78	+0.71	-1.63	1956	Nov. low.
Sand and gravel in Puget Trough, Tacoma, Washington.	-102.46	+7.19	+0.66	+0.24	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3).	-463.1	-2.8	-0.7	-3.5	1929	
Snake River Group: Snake River Plain Aquifer, at Eden, Idaho (U.S. well no. 4).	-118.4	-2.5	-0.3	...	1957	
Alluvial valley fill in Flowell area, Millard County, Utah (U.S. well no. 9).	-6.50	+22.26	+0.98	-1.68	1929	
Alluvial sand and gravel, Platte River Valley, Ashland, Nebraska (U.S. well no. 6).	-2.20	+4.08	-1.37	+3.60	1935	Nov. high.
Alluvial valley fill in Steptoe Valley, Nevada....	-7.70	+5.29	+0.34	+0.45	1950	Nov. high.
Pleistocene terrace deposits in Kansas River valley, at Lawrence, northeastern Kansas.	-15.10	+5.65	+0.47	+0.56	1953	Nov. high.
Alluvium and Paso Robles clay, sand, and gravel, Santa Maria Valley, California	-117.30	+26.09	+1.70	-10.01	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15).	-103.5	-22.8	+0.5	+1.5	1951	
Hueco bolson, El Paso area, Texas.....	-266.15	-19.03	+0.98	-1.71	1965	Nov. low.
Evangeline aquifer, Houston area, Texas.....	-315.60	-11.57	+2.62	-0.42	1965	

**DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR NOVEMBER 1986, AT
DOWNSTREAM SITES ON FIVE LARGE RIVERS**

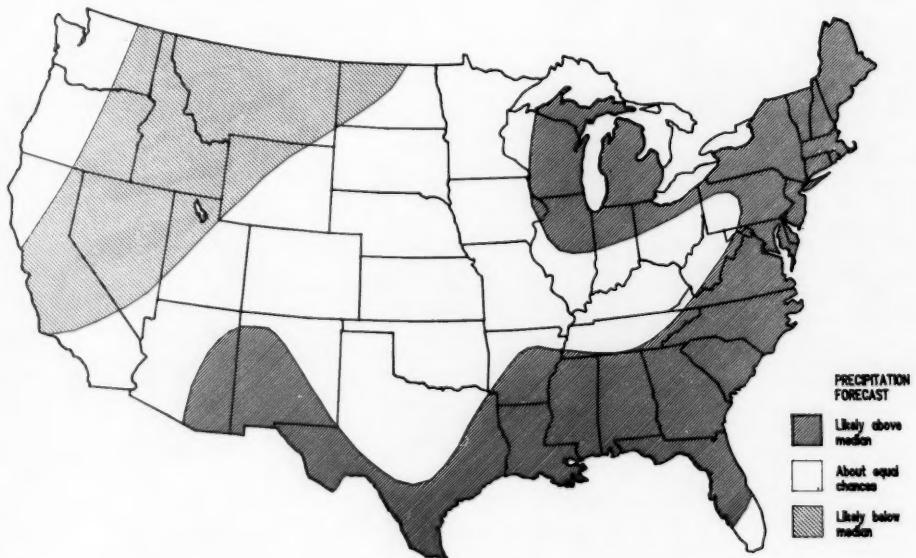
Station number	Station name	November data of following calendar years	Stream discharge during month	Dissolved-solids concentration ^a		Dissolved-solids discharge ^a			Water temperature ^b		
				Minimum Mean (cfs)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean in °C	Minimum, in °C	Maximum, in °C
				(tons per day)							
01463500	Delaware River at Trenton, NJ (Morrisville, PA).	1986 1944-85 (Extreme yr)	13,590 9,988 9,825 (1955)	68 55 124 151 (1964)	3,140 (1963)	994 469 7,750 12,300 (1972)	7.5 (1972)	4.0 2.0 13.0 19.0			
07289000	Mississippi River at Vicksburg, MS.	1986 1975-85 (Extreme yr)	804,100 458,500 320,600 (1984)	230 181 260 305 (1983)	511,700 294,400 (1983)	434,000 123,000 27,200 677,800 (1976) (1985)	574,600 123,000 406,000 677,800 (1985)	13.0 13.5 11.0 9.0	9.0 8.0 18.5 20.0		
03612500	Ohio River at lock and dam 53, near Grand Chain, IL (streamflow station at Metropolis, IL).	1986 1954-85 (Extreme yr)	216,000 181,600 147,600 (1957)	164 129 260 425 (1968) 144,000 88,940 (1980)	13,900 27,200 128,000 43,600 (1976)	276,000 406,000 164,000 246,000 (1985) 7.0 9.5	11.0 1.0 5.5 3.5	18.5 19.5 9.0 15.0	
06934500	Missouri River at Hermann, MO (60 miles west of St. Louis, MO).	1986 1975-85 (Extreme yr)	147,000 87,590 54,680 (1985)	312 204 105 506 (1980)	144,000 88,940 119 37,300 (1980)	128,000 43,600 32,800 10,800 (1980)	164,000 246,000 53,200 66,400 (1978)	11.5 11.0	9.0 3.0	13.5 14.5	
14128910	Columbia River at Warrendale, OR (streamflow station at The Dalles, OR).	1986 1975-85 (Extreme yr)	141,000 133,600 87,960 (1980)	105 38 119 128 (1978)	43,000 37,300 (1978)	32,800 10,800 53,200 66,400 (1980)	53,200 66,400 11.0 11.0				

^aDissolved-solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.

^bTo convert °C to °F: $[(1.8 \times ^\circ\text{C}) + 32] = ^\circ\text{F}$.

^cMedian of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

PRECIPITATION OUTLOOK FOR DECEMBER 1986 THROUGH FEBRUARY 1987



(From Monthly and Seasonal Weather Outlook Published by National Weather Service)

NATIONAL WATER CONDITIONS December 1986

Based on reports from the
Canadian and U.S. Field offices;
completed December 15, 1986

TECHNICAL STAFF

Thomas G. Ross, Editor
Carroll W. Saboe
John C. Kammerer
Allen Sinnott
Krishnaveni V. Sarma
Sharon A. Edmonds
Carole J. Marlow

COPY PREPARATION

Lois C. Fleshmon
Sharon L. Peterson
Aisha P.R. Law

GRAPHICS

Frances B. Davison
Carolyn L. Moss

The National Water Conditions is published monthly. Subscriptions are free on application to the U.S. Geological Survey, 419 National Center, Reston, VA 22092.

EXPLANATION OF DATA (Revised August 1986)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 184 index gaging stations—18 in Canada, 164 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951–80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, one New York index station, and the Puerto Rico index stations because of the limited records available.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude—the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest 25 percent of flows and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range) 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as; *above normal* if it is greater than the upper quartile, *in the normal range* if it is between the upper and lower quartiles, and *below normal* if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as *seasonal* if the change is in the same direction as the change in the median. If the change is in the opposite direction of the

change in the median, the change is classified as *contraseasonal* (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. *Probability of occurrence* is the chance that a given flood magnitude will be exceeded in any one year. *Recurrence interval* is the reciprocal of probability of occurrence and is the *average number of years between occurrences*. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. *Recurrence intervals imply no regularity of occurrence*; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about *ground-water levels* refer to conditions near the end of the month. The water level in each key observation well is compared with average level for the end of the month determined from the 30-year reference period, 1951–80, or from the entire past record for that well when only limited records are available. Comparative data for ground-water levels are obtained in the same manner as comparative data for streamflow. *Changes in ground-water levels*, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data for November are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). *Dissolved solids* are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. *Dissolved-solids discharge* represents the total daily amount of dissolved minerals carried by the stream. *Dissolved-solids concentrations* are generally higher during periods of low streamflow, but the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

METRIC EQUIVALENTS OF UNITS USED IN THE NATIONAL WATER CONDITIONS

1 foot = 0.3048 meter

1 acre-foot = 1,233 cubic meters

1 million cubic feet = 28,320 cubic meters

1 cubic foot per second =

0.02832 cubic meters per second =

1.699 cubic meters per minute

1 cubic foot per second · day = 2,447 cubic meters

1 mile = 1.609 kilometers

1 square mile = 259 hectares = 2.59 square kilometers

1 million gallons = 3,785 cubic meters =
3.785 million liters

1 million gallons per day = 694.4 gallons per minute =
2.629 cubic meters per minute =
3,785 cubic meters per day

(Round-number conversions, to nearest four significant figures)

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DEPARTMENT OF THE INTERIOR

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